

Proceedings of the Aquaculture Workshop for SEAFDEC/AQD Training Alumni; 8-11 September 1992; Iloilo, Philippines. SEAFDEC Aquaculture Department, Iloilo, Philippines. 1993. 173 pp.

FISH NUTRITION IN THAILAND: STATUS AND CONSTRAINTS

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Aquaculture prior to World War II was limited because marine and freshwater fish catches were still abundant. But shortage of fuel and other necessities led to an increase in food prices including fish. The demand for increased fish production in turn increased the number of people involved in fish farming and the number of species cultured to more than 25. The 13 species most commonly cultured include the walking catfish (*Clarias batrachus*), snakehead (*Channa straitus*), striped catfish (*Pangasius sutchi*), gouramy (*Trichogaster pectoralis*), sand goby (*Oxyeleotris marmoratus*), grass carp (*Ctenopharyngodon idellus*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Aristichthys nobilis*), Nile tilapia (*Oreochromis niloticus*), freshwater prawn (*Macrobrachium rosenbergii*), sea bass (*Lates calcarifer*), grouper (*Epinephelus tauvina*), and tiger shrimp (*Penaeus monodon*).

Thailand is a major producer of agricultural products in Asia. Large quantities of raw feed materials are produced and consumed each year. Although aquaculture has been in existence as long as land-based agriculture, it has not kept up in terms of feed development. The feeding methods of most cultured fishes are still largely traditional and based on experience using trash fish, rice bran, and broken rice. It was only recently that aquaculture began using feeds to increase production. In 1986, shrimp culture began evolving toward the semi-intensive and intensive systems, and the demand for compound feeds greatly increased. Commercial feed factories expanded to include shrimp feeds, further developing the feed industry.

Status

Development of dry feeds to replace trash fish. The mixture of trash fish and rice milling by-products are still widely used for carnivorous species, and so far, there are no attempts to change this. Availability of trash fish is not a problem yet for those near the coasts; however, it hinders fish farming in inland areas because of quality deterioration during transport and other problems. The Department of Fisheries has, thus, convinced fishfarmers to use well-established dry feeds for cultured species. At the same time, the feasibility of using dry feeds for strictly trash fish-dependent species like sand goby, snakehead, sea bass, and grouper is under investigation.

Table 1. The standard characteristics proposed by the Department of Fisheries for fish and shrimp feeds

	Size (cm)	Pro- tein ¹ (%)	Fat ² (%)	Fiber ¹ (%)	Ash ¹ (%)	Mois- ture ¹ (%)	P (%)	Oth- ers (%)
Marine shrimp feed								
Postlarvae (7-20 days)	0.5	40	4	4	16	12	1.4	-
Postlarvae (0.2-1.5 g)	1.8	40	4	4	16	12	1.4	-
Juveniles (1.5-5g)	2.5	40	4	4	16	12	1.4	2
Young shrimp (5-12g)	3.0	38	4	4	18	12	1.4	2
Adult shrimp (12-40g)	-	36	4	4	18	12	1.4	2
Freshwater prawn feed								
Young prawn (5-12g)	3.0	30	3	6	18	12	1.0	2
Adult prawn (12-40g)	-	25	3	6	18	12	1.0	2
Fish feed								
Catfish (4 days-1 month)	-	30	3	8	16	12	1.0	-
Catfish (1 month-3 months)	-	30	3	8	16	12	1.0	-
Catfish (over 3 months)	-	25	3	8	16	12	1.0	-
Other herbivorous fishes	-	18	3	8	16	12	1.0	-

¹Maximum. ²Minimum. P, phosphorus.

Development of fish feed using locally available raw materials. Good fish feed formulas are useless if ingredients are not available in the region. Ideally, fish feeds provide adequate nutrition and are developed from locally available raw materials. Also, their preparation must not be very complicated. Agricultural crops grown in the country are the best guides for developing fish feeds. For instance, rice, corn, cassava, soybean, and their products could be used in fish feeds for the northeastern region while oil-palm products could be a potential feed ingredient for the south.

Standard legislation for aquafeeds. Thailand is one of the world leaders in aquaculture production. The total production of marine shrimp alone is valued in 1991 to be 14,000 million baht. Such a big industry consequently increases demand for feeds. At present, 17 aquafeed mills are in operation with an annual production of 240,000 t or a total production value of 7,500 million baht. The Department of Fisheries realizes that uncontrolled and inconsistent feed quality can cause huge losses for the farmers. Therefore, it proposed standard legislation regarding aquafeeds for consumer protection (Table 2). The legislation guarantees quality.

About one-third of aquafeeds produced in the country are for fish, the rest for shrimp. The following feed plants all produce shrimp feeds; plants 1,4,10, 14,15, and 16 produce fish and shrimp feeds.

1. C.P. Animal Feeds
2. Laemthong Aquatech
3. S.T.C. Feeds
4. P. Chareonphan Animal Feeds
5. Aquastar
6. U.K. Feedmills
7. Thailux Enterprise
8. Grobest Corporation
9. Apitune Sea Food
10. Unicord Feeds
11. Lee Patana
12. Centago
13. Bangkok Animal Feeds
14. Na NA Food Products
15. Sahapatanakaset
16. Feed Specialty
17. Cargill

There are three types of feed produced in the country: fish feed, freshwater prawn feed, and marine shrimp feed.

The feed stuffs for aquaculture are almost the same types used for livestock but the composition of feeds is different. Some of the ingredients used in aquaculture and their nutritional values are shown in Table 2.

Because of adequate animal feedstuffs in the country, animal feed milling is one of the fastest growing industries. The (sinking) dry pelleted feed for catfish was introduced about 20 years ago but few used the feed because it was priced higher than the fish in the market. The feed milling industry then introduced the floating-type pelleted feed. However, traditional practices using fresh trash fish detract the farmers from using them even when feed conversion ratio (1.5:1) was claimed to be lower. This situation slowed the development of compound feeds in aquaculture. Just recently, farmers realized the convenience of using complete feeds, increasing consumption of dry and floating pelletized feeds. When the freshwater prawn and marine shrimp cultures expanded because of adequate seed supply, the need for compound feeds rapidly increased, and many feedmills improved or increased quality and quantity of available feeds. New feedmills that cater to aquaculture were established in 1986-1988. The Department of Fisheries is monitoring these feed milling plants.

There are several shrimp feeds formulated for different levels of culture because of the differences in stocking rates, the natural food available, the production expected, and the level of knowledge on nutrient requirements of aquatic animals. Some known formulations are shown in Tables 3 and 4.

Feeds for herbivorous, omnivorous, and carnivorous fishes are not formulated according to nutrient requirements but are based on the price of the product at the end of culture. Some feed formulations are shown in Tables 5 and 6.

Table 2. Common feedstuffs used in diet formulation

Feedstuff	Dry matter (%)	Crude protein (%)	Crude fat (%)	Crude fiber (%)	Ash (%)	NFE (%)	Bath/kg (%)
Broken rice	87.3	10.2	1.9	1.4	1.2	85.3	6.00
Maize	87.8	10.0	4.5	2.8	2.4	80.3	3.00
Sorghum	85.4	11.1	3.7	6.1	4.1	74.8	3.00
Cassava meal	87.7	4.6	1.1	3.8	6.5	84.0	1.75
Rice bran (raw)	90.0	14.0	15.2	12.7	13.5	44.6	3.00
Soybean meal	88.5	54.2	1.2	5.3	7.9	31.4	8.30
Cottonseed meal	91.6	45.4	1.3	14.5	11.4	27.4	6.50
Sesame seed meal	90.1	51.0	1.3	6.8	12.9	28.0	7.00
Ipil-ipil meal	90.1	18.9	2.8	24.6	11.4	42.4	2.70
Fish meal	93.1	57.0	8.5	2.1	25.0	7.4	10.00
Meat meal	93.0	54.3	10.6	2.2	30.5	2.4	NP
Feathermeal	93.0	91.7	3.2	1.3	3.8	0.0	5.0
Shrimp meal	90.0	49.9	3.3	12.5	30.2	4.1	NP
Yeast	93.0	51.5	2.6	2.5	8.6	34.8	NP
Molasses	85.0	5.4	0.3	9.9	10.3	74.0	1.50
Bone meal	97.0	11.5	9.4	1.7	77.4	-	5.00

NFE, nitrogen-free extract; NP, no price obtained.

The feed formulations are also made according to culture system, age of fish, environmental condition, price of the product, cost of feed, and availability of local ingredients.

Table 3. Feed formula for *P. monodon*

Ingredients	%
Fish meal	30
Soybean meal	25
Shrimp head and wastes	10
Squid meal	6
Yeast	2
Broken rice	12
Rice bran	10
Guagum	1
Premix	0.8
Mineral mix	0.2
Vitamins	2.0
Diphosphate	1.0

Table 4. Shrimp feed with trash fish as the major component

Ingredients	%
Trash fish	40
Fish meal	10
Shrimp head and waste	8
Soybean meal	16
Rice bran	12
Broken rice	10
Ipil-ipil	3.3
Vitamin premix	0.5
Vitamin C	2

Table 5. Feed for herbivorous species, e.g., carp and catfish

Ingredients	%
Fish meal	16
Peanut meal	24
Soybean meal	14
Rice bran	30
Broken rice or cassava meal	15
Vitamin and mineral premix	1

Table 6. Feeds formulated for fry of carnivorous species

Ingredients	%
Fish meal	56
Rice bran	12
Soybean meal	12
Alpha starch	14
Vitamins and mineral	1.6
Binder (bass fin)	0.4
Fish oil	4

Problems and constraints

- Most of the efforts to increase aquatic animal production went into seed supply and very limited funds are given to studies on aquatic animal nutrition and fish feed technology.

- Most of the formulations for aquatic animal feeds are based on experience with land animals. Very few fish nutrition studies and fish feed technology exist. The lack of research in this field reflects the slow process of development.

- The subject is complicated and special instruments are required but government budget alone is not enough. The assistance of international agencies to enhance research would promote better development.

- Many species of fish and shrimps need to be studied and the conditions of culture systems need to be standardized.

- The high price of formulated feeds for some species is not economically appropriate for commercial application. Studies on waste products as substitutes to expensive feed ingredients need to be undertaken.

Discussion

The technical issues discussed by the workshop participants include:

- Shortage of quality feed ingredients
- Upgrading of low-quality feeds by several processing techniques
- Formulated feeds are less acceptable in Malaysia than trashfish. Trashfish supply is adequate and it costs lower (R3/kg) than formulated feeds (US\$1/kg). Supply, however, is not unlimited and may decrease like in Thailand.
- Survival of farmed species fed locally produced feeds and those fed imported feeds
- Proximate analysis of feeds used in tiger shrimp culture
- Feeding broodstock
- Control measures on feed quality imposed by the Government of Thailand
- Basis for nutritional requirement; lipid requirement for tiger shrimp